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Department of
Agriculture

Animal and
Plant Health
Inspection
Service

Plant Protection
and Quarantine

Cooperating State
Departments of
Agriculture

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ACTION PLAN

EGGPLANT FRUIT BORER

Leucinodes orbonalis Guenee

This PPQ Action Plan or New Pest Response Guideline has not been updated since its publication date. The actions or guidelines recommended may not be appropriate now, new survey tools may be available, and chemical pesticides named may no longer be registered. This documents is posted until updated versions can be drafted and as such are only guidelines that represent the state of knowledge at the time they were written. Please consult PPQ and/or your State Plant Regulatory Official prior to implementing any recommendations listed herein.

INDEX

	<u>Page</u>
Index.....	i
Authorization.....	iii
Notice.....	iv
 I. General Information.....	 I-1
A. Action Statement.....	I-1
B. Background Information.....	I-1
C. Life Cycle Application.....	I-1
 II. Survey Procedures.....	 II-1
A. Delimiting Survey.....	II-1
B. Monitoring/Evaluation Survey.....	II-3
C. Host Collection and Holding.....	II-3
D. Detection Survey.....	II-3
E. Orientation of Survey Personnel.....	II-3
F. Survey Records.....	II-3
 III. Regulatory Procedures.....	 III-1
A. Instructions to Officers.....	III-1
B. Regulated Articles.....	III-1
C. Quarantine Actions.....	III-2
D. Regulated Establishments Inspection....	III-3
E. Use of Authorized Chemicals.....	III-4
F. Approved Regulatory Treatments.....	III-4
G. Principal Activities.....	III-4
H. Orientation of Regulatory Personnel....	III-5
I. Regulatory Records.....	III-5
 IV. Eradication Procedures.....	 IV-1
A. Recommended Pesticides.....	IV-1
B. Approved Eradication Treatments.....	IV-1
C. Eradication/Control Method Selection...	IV-2
D. Orientation of Eradication/Control Personnel.....	IV-3
E. Eradication/Control Records.....	IV-3
F. Monitoring.....	IV-3

V. Contacts.....	V
VI. Addenda	VI
Definitions.....	VI-A
Safety.....	VI-B
Hosts.....	VI-C
Life History.....	VI-D
Identification of Specimens.....	VI-E
Technical Application Data.....	VI-F
Forms.....	VI-G
Contributors.....	VI-H
References.....	VI-I

AUTHORIZATION

This Action Plan provides guidelines and actions for the eradication of an eggplant fruit borer infestation. This Action Plan supplements information contained in the Plant Protection and Quarantine (PPQ) Treatment, Emergency Programs, and Administrative Procedures Manuals.

It is to be used in conjunction with other manuals when conducting emergency program activities. The information and instructions contained in this Action Plan were developed with and approved by representatives of cooperating States, the U.S. Department of Agriculture's Agricultural Research and Cooperative State Research Services, and affected industry.


All program technology and methodology employed are determined through discussion, consultation, or agreement with the cooperating State officials.

NOTICE

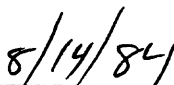
Recommendations in this Action Plan, which involve the use of pesticides, concern products which are registered or exempted under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Precautions on the pesticide label and all instructions in this Action Plan must be carefully followed.

Federal and/or State personnel may not make any warranty or representations, expressed or implied, concerning the use of these products and shall not be responsible for any loss, damage, or injury sustained as a result of the use of any product as specified in this Action Plan.

The use of trade names in this Action Plan does not imply an endorsement of those products or of the manufacturers thereof by Federal-State pest control programs. Equivalent formulations under different trade names are acceptable.



Deputy Administrator
Plant Protection and Quarantine



Date



Chairman
National Plant Board



Date

I. GENERAL INFORMATION

A. Action Statement

The information contained in this document is intended for use when an eggplant fruit borer infestation is known to exist. This Action Plan is to be used for guidance in implementing eradication procedures and in preventing spread to other locations. It provides technical and general information needed to implement any phase of an eggplant fruit borer eradication program. Specific program action is to be based on information available at that time.

B. Background Information

The eggplant fruit borer is native to Asia. This pyralid moth is widespread in both Asia and Africa, including Sri Lanka, Indonesia, the Philippine Islands, west, middle, and south Africa. It is recorded from 16 hosts, of which eggplant, potato, and tomato are preferred. It is very frequently intercepted in fruit of these hosts from both Africa and Asia. This insect is primarily considered a pest of the potato, tomato, and eggplant industries, but could prove to be of concern to the cucurbit and pea industries as well. Plant injury results from boring and feeding of the larva into the growing points, stem, and fruit of the host.

Development from egg to adult, in constant optimum temperature of 30° C. (86° F.) and 70 to 90 percent relative humidity, takes approximately 22 days. The adult usually becomes sexually mature after 3 days, and one generation requires approximately 25 days under these conditions. It is likely this species can exist in any of the conterminous United States.

C. Life Cycle Application

Insect development is temperature dependent. For eggplant fruit borer, egg to adult development is influenced by air temperatures. Larval development depends on internal host temperatures and pupal development depends on the location of the pupa, which may be in air, soil, or rarely in the fruit. In each environment, a minimum temperature exists below which no measurable development takes place. While at present the exact threshold has not been estimated for eggplant fruit borer, it would have to be below and very close to 15° C. (59° F.). A model can be designed to use modified air temperature data for all insect stages and to predict the entire life cycle.

Program actions are guided in part by the insect life cycle data. Eradication treatments, length of trapping activities, and regulatory functions are affected primarily by the length of time it takes to complete each phase of the life cycle. Temperature data are available from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, private, State, university, or industry sources, or can be generated by strategically placing thermometers on the soil surface.

II. SURVEY PROCEDURES

A. Delimiting Survey

1. There are two primary survey systems which must be used to complement each other if an eggplant fruit borer infestation is to be adequately delimited.

When one or more eggplant fruit borers are collected in an area, a delimiting survey will be implemented immediately to determine the population distribution.

a. Trap

Using the site of the detection as the focal point (epicenter), 16 blacklight traps will be set out in a core area of 4 square kilometers (sq km) (1.54 sq mile (mi)) in host fields with a bias for preferred hosts and, where possible, four traps in each km. Traps will be serviced every day. Place traps in or near hosts. Traps will be maintained through three eggplant fruit borer generations after the last find.

b. Visual

Using the site of the detection as the focal point (epicenter), locate suitable host fields in each km of the core. Up to 100 hectares (ha) (approximately 250 acres(a)) of host, if available, are to be surveyed in the core. This will include 20 ha (50 a) in each sq km and around the epicenter where the find was made or nearest feasible host field. Each field, with a maximum 4 ha (10 a) each, will be sampled at five locations in three rows of host and a minimum of 50 plants for the presence of eggs under leaves and larvae in fruit, stem or growing points as indicated by holes in fruit, bored stems, dead or withered tips, and cocoons on the stem, fold of a leaf, on or in the ground as given in Addenda D3 and F2.

Mango trees are an exception. In this instance, a tree may be checked for cocoons about the base and any fallen fruit examined for evidence of boring. A limited sample of 10 suspect fruit per tree may also be examined at the discretion of the officer.

After harvest, the above activity will be replaced by the selection of 50 to 100 plant stalks or stubble at each location. These are pulled from the ground and above and below ground parts examined for cocoons. Immediately adjacent leaf litter and soil will also be examined for the presence of cocoons.

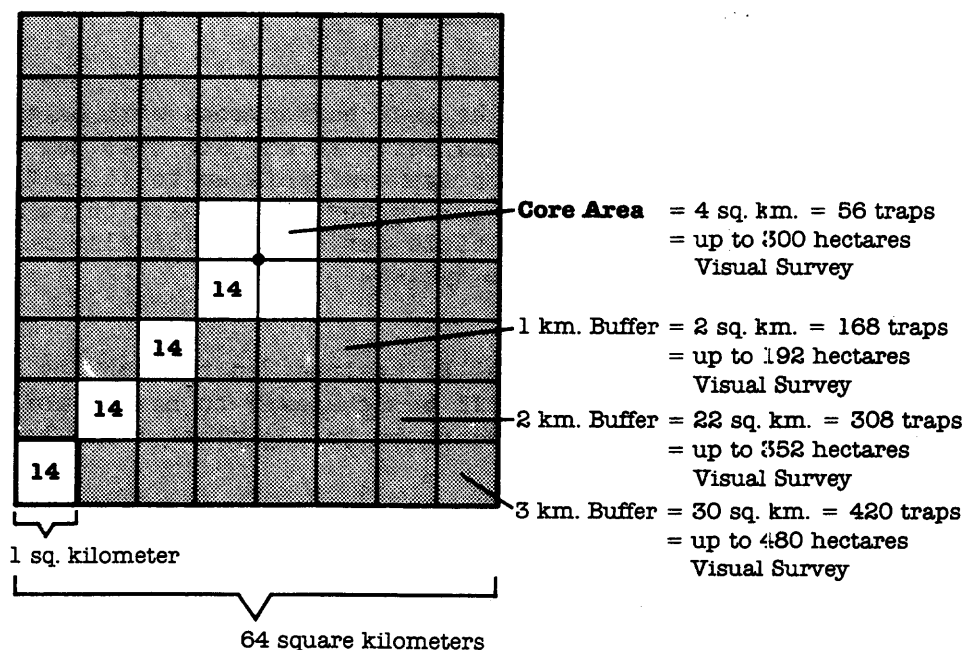
The visual survey will be repeated once a week in other available host fields, if possible, for at least three eggplant fruit borer generations. It will be rotated to allow coverage of the entire core area over a 4-week period and will be maintained through three eggplant fruit borer generations after the last find.

2. The extent of survey operations is given as follows:

a. If only one insect (any stage) is detected, the delimiting survey is limited to the 4-sq-km (1.54-sq-mi) core area.

b. If two or more detections are made within a 4-sq-km (1.54-sq-mi) area, the delimiting survey will be conducted over 36 sq km (about 14 sq mi). Traps will be deployed in the core areas at the rate of four per sq km and at the rate of two per sq km in the 1- and 2-km (0.62- and 1.24-mi) buffers. A larval and cocoon survey will also be carried out in the core areas and the first and second buffers, the latter at the rate of a minimum of 16 ha (approximately 38 a) per sq km (approximately 100 per sq mi).

Survey Per Square Kilometer



c. If six or more detections are made in an area involving 16 sq km (6 sq mi) or more, the delimiting survey will be conducted over a 64-sq-km (25-sq-mi) area. Traps will be deployed in the core and buffer areas 1, 2, 3 km (0.62, 1.24, 1.86 mi) as in 2a and b above. A larval and cocoon survey will also be carried out as in 2a and b.

- B. Monitoring/
Evaluation
Survey A monitoring/evaluation survey will be conducted in that area where eradication treatments are applied. The traps and visual survey systems are maintained at the delimiting rate.
- C. Host
Collection
and Holding Selected hosts (fruit, stem, stubble with cocoons, and leaves with eggs or cocoons, or cocoons found loose in the soil) that are collected in the field or at market sites with unidentifiable specimens will be held for at least one eggplant fruit borer life cycle at temperatures and humidity which will permit insect development for identification.
- The facility where the hosts are held must be secure to prevent any inadvertent release of moths. Security measures must be equal to those established for a quarantine insect-rearing facility. See Animal and Plant Health Inspection Service 81-61 for detailed information.
- D. Detection
Survey The area beyond the last buffer zone will be trapped at a minimum rate of three traps per 8 sq km (one trap per sq mi) for two life cycles where hosts are available up to 16 km (10 mi) from the epicenter. A visual survey of at least three 4-ha (10-a) fields per 8 sq km (one field per sq mi) will also be continued in this area for two life cycles.
- E. Orientation
of Survey
Personnel New personnel will be trained, on the job, by experienced personnel. It will be necessary to have 3 working days to teach the many facets of the eggplant fruit borer survey.
- F. Survey
Records Records noting the areas surveyed, sites trapped, dates, locations, and hosts in which detections were made will be maintained (see Addendum G).

III. REGULATORY PROCEDURES

A. Instructions to Officers

Regulatory actions will be required until the pest is eradicated. Officers must follow instructions for regulatory treatments or other procedures when authorizing the movement of regulated articles. Understanding the instructions and procedures will serve as a basis for explaining such procedures to persons interested in moving articles affected by the quarantine and regulations. Only authorized treatment procedures may be used.

General instructions that are to be followed in regulatory treatments are found in the PPQ Treatment Manual.

Officers may aid shippers in selecting the authorized treatment or procedure that is most practical for the shippers. They should advise the shipper to apply selected treatments to small quantities of material prior to treating larger quantities to determine the reaction or effects of the treatment procedure. When treating commodities, which are particularly sensitive to the treatments selected, treat more of the commodity than is needed to allow for possible losses.

B. Regulated Articles

1. Any part of the following:

Common Name

Scientific Name

Black nightshade
Cape gooseberry
Eggplant
Ground cherry, A
Mango
Okra
Peas
Pepper
Potato
Scarlet eggplant
Squash
Tomato
Tree tomato
Turkeyberry

Solanum nigrum
Physalis peruviana
Solanum melongena
Physalis minima
Mangifera indica
Abelmoschus esculentus
Pisum sativum
Capsicum spp.
Solanum tuberosum
Solanum integrifolium
Cucurbita maxima
Lycopersicon esculentum
Cyphomandra betacea
Solanum torvum

2. Soil within the drip area of plants which produce the fruits, berries, or vegetables listed above.

3. Any other product, article, or means of conveyance, of any character whatsoever, when it is determined by an inspector that they present a hazard of spread of eggplant fruit borer and the person in possession thereof has been so notified.

C. Quarantine
Actions

When detections are made, the following steps should be implemented in sequence:

1. With the detection site considered the epicenter, all growers and establishments that grow, handle, move, or process regulated articles within a minimum of 3 linear km (approximately 1.86 mi) will be issued emergency action notifications requiring treatment or other approved handling procedures. Emergency Action Notifications (PPQ Form 523) and/or comparable State notifications are issued by field personnel to the property owners or managers of all establishments who grow, handle, move, or process articles capable of spreading the eggplant fruit borer. A notification will be issued pending authoritative confirmation and/or further instruction from the Deputy Administrator.
2. If necessary, the Deputy Administrator will issue a letter directing PPQ field offices to initiate specific emergency action under the Federal Plant Pest Act (7 U.S.C. 150dd) until emergency regulations can be published in the Federal Register.

The Federal Plant Pest Act of 1957 provides for authority for emergency quarantine action. This provision is for interstate regulatory action only; intrastate regulatory action is provided under State authority. However, if the Secretary of Agriculture determines that an extraordinary emergency exists and that the measures taken by the State are inadequate, USDA can take intrastate regulatory action provided that the Governor of the State has been consulted and a notice has been published in the Federal Register.

The Organic Act of 1944, as amended, provides the Federal Government, either independently or in cooperation with States or political subdivisions thereof, farmers' associations and similar organizations, and individuals, the authority to carry out operations or measures to detect, eradicate, suppress, control, or to prevent or retard the spread of plant pests. This Act does not provide for trespassing on private property, but relies upon State authority and willingness to use State right-of-entry authority.

All program technology and methodology employed are determined through discussion, consultation, or agreement with the cooperating State officials.

3. The Deputy Administrator, through the National Regional Directors, will notify State cooperators of the eggplant fruit borer detection, actions taken, and actions contemplated.

A narrative description of the regulated area with support documents will be developed by USDA and cooperators and provided to the Regulatory Services Staff, National Program Planning Staff (NPPS). The regulated area will also be defined by the Universal Transverse Mecator grid marking system for use by the Project Manager.

4. APHIS Regulatory Coordination Staff will publish in the Federal Register emergency regulations under the Federal Plant Pest Act. The regulated area will also be defined by the Universal Transverse Mecator grid marking system for use by the Project Manager.

5. After a reasonable time, taking into consideration such factors as the biology of the pest, climatic conditions, and infestation spread, a proposal to promulgate a quarantine under the Plant Quarantine Act will be published. The proposal will announce a date for submitting written comments, which shall be approximately 60 days after publication.

6. After receipt of written comments, a final determination specifying the action decided upon will be published in the Federal Register. If after consideration of the comments a quarantine is warranted, it would be invoked under the Plant Quarantine Act.

D. Regulated
Establishments
Inspection

Efforts to detect the pest within the regulated area will be made at all establishments where regulated articles are grown, handled, moved, or processed. Establishments that might be involved are: Airports, landfill sites, processing plants, farmers' markets, produce markets, nurseries, flea markets, and any other establishments that handle regulated articles. At these premises, a visual examination of host material and containers will be necessary to detect the presence of larvae, particularly where fruits or vegetables are handled. Suspect fruit or vegetables, that appear to be bored or otherwise in poor condition, will be split and examined, as will any other host material such as roots for cocoons. If there is a large amount of suspect material, it may be necessary to take a large sample of 50 to 100 specimens from stockpiles for examination. A minimum of 20 samples of five selections each may be examined at each establishment. At the discretion of the examining officer, one blacklight trap per establishment may be set and serviced one night weekly if trap catches of insects are high or set to run nightly and serviced once a week if trap catches are low.

**E. Use of
Authorized
Chemicals**

The PPQ Treatment Manual and this Action Plan contain the authorized chemicals, methods, and rates of application, and any special application instruction. Concurrence by PPQ's Survey and Emergency Response Staff (SERS) is necessary for the use of any chemical or procedures for regulatory purposes.

**F. Approved
Regulatory
Treatments**

1. Fumigation. The application of an approved fumigant as a treatment (methyl bromide) or in conjunction with refrigeration or vacuum treatment procedures.

2. Steam Sterilization. The use of live steam as a treatment alone.

3. Sanitation. The removal and destruction of leaves, stems, stalks, roots, rotting or fallen fruit, vegetables, berries, and other host material.

**G. Principal
Activities**

The following identifies principal activities necessary for conducting a regulatory program to prevent the spread of eggplant fruit borer. The extent of regulatory activity required is dependent on the degree of infestation. For example, safeguarding vegetable stands throughout the entire regulated area which are engaged in only local retail activity may not be necessary when the regulations that are imposed are based on a limited and light infestation. Mandatory checks of passenger baggage (i.e., for fruit) at airports and the judicious use of road patrols and roadblocks may be necessary where general or heavy infestations occur.

1. Advising regulated industry of required treatment procedures.

2. Supervising, monitoring, and certifying commodity treatments of commercial lots of regulated articles.

3. Contact visits with:

a. Security and airline personnel.

b. Vegetable stands.

c. Local growers, packers, and processing plants.

d. Farmers', produce, and flea markets.

e. Commercial haulers of regulated articles.

f. Public transportation.

4. Visiting canneries and other processing establishments.
5. Monitoring the movement of waste material to and from landfills to ensure adequate disposal of regulated article refuse.
6. Monitoring the movement of regulated articles through major airports and other transportation centers.
7. Movement of host materials along major highways and across quarantine boundaries.

H. Orientation
of Regulatory
Personnel

Only trained or experienced personnel will be used initially. Replacement personnel will be trained by the individual being replaced. A training period of 3 working days is necessary for the orderly transfer of these functions.

I. Regulatory
Records

Records will be maintained, as necessary, to carry out an effective, efficient, and responsible regulatory program (see Addendum G).

IV. ERADICATION PROCEDURES

Survey and Emergency Response Staff, in consultation with methods and research agencies, outlines treatments to be used and must be notified of all treatment plans. If treatments selected or proposed are not in conformance with current pesticide labels, an emergency exemption may be provided under Section 18 of the FIFRA, as amended. For further instructions, see Emergency Programs Manual, Section V, B.

Eradication of an eggplant fruit borer infestation is essential. Local conditions will determine the most acceptable procedures to achieve eradication.

A. Recommended Pesticides

1. Carbaryl
2. Fenvalerate

Data on related species indicate that alternative insecticides may be equal or more effective. At the initiation of a program, an evaluation of other available insecticides for use on program operations will be made.

B. Approved Eradication Treatments

1. Ground Spray

Ground application of insecticide will be initiated immediately. All host plants which provide for reproduction of the eggplant fruit borer on the infested property, adjacent property, and within 200 meters (m) (216 yards (yd)) of the known infestation will be sprayed at the prescribed intervals if host material is scattered or infestation is light. Spraying may be extended to cover adjacent properties if they have substantial host material. Ground application in large infestations will be applied to host material to a minimum of 3 linear km (1.86 mi) beyond any known infestation. Ground spraying may be discontinued after an estimated two generations of negative survey or after the initiation of aerial treatment.

2. Aerial Spray

Aerial application of insecticide should be initiated immediately. Aerial sprays will be applied when and where ground treatment is not practical. Application will be made at the prescribed intervals over a minimum period equal to two life cycles of negative trapping. The number of applications will vary depending on the estimated day degree accumulations in the infested area. The area to be sprayed will extend a minimum of 3 linear km (1.86 mi) beyond any known infestation. Weather conditions may dictate changes in spray schedule. After an estimated two generations of negative trapping and survey, spray

operations may be discontinued. Nonhost areas or areas with very little host material are not to be sprayed and will be handled by ground treatments.

The decision to apply insecticide applications will be based on the best weather information available. In the event rain washes an application from the foliage, plans will be implemented to retreat the area.

Retreatment should not be considered if weather reports indicate a 50-percent or greater chance of precipitation in the 48-hour period following washoff.

The objectives are to eradicate the pest and minimize environmental contamination. Any treatment or retreatment recommendations must consider these objectives.

3. Supplemental Methods

a. Sanitation: Sanitation measures will be carried out in nurseries, farms, gardens, and other establishments where hosts are present within the core and buffer areas.

b. Host Destruction: In situations with a very limited area of infestation, consideration will be given to the destruction of hosts by (1) herbicides, (2) disking or plowing, or (3) removal and burial or incineration. All host material must be completely destroyed.

C. Eradication/ Control Method Selection

The following parameters or criteria will determine the minimum treatments to achieve eradication. Expanded or additional treatment actions can be applied if mutually agreed by cooperating agencies.

Eradication measures will continue for at least two generations and trapping will continue for at least three generations following the last detection.

1. If one adult male or one unmated adult female is detected in and urban/residential or commercial production area, no eradication treatments will be initiated.

2. When one to five mated females, larvae, or pupae, or two to five males/unmated females are detected in an area of less than 16 sq km (6 sq mi), sanitation, host destruction, and ground applied foliar sprays will be employed. Similar detections in a commercial area will require treatment by sanitation, host destruction, and ground or aerial sprays, as applicable, and extend 200 m (216 yd) beyond any known infestation.

3. When more than six detections of any stage(s) are detected in an area greater than 16 sq km (6 sq mi), ground and aerial applications will be employed, include, and extend 3 km (1.86 mi) beyond the known infestation. Sanitation and host destruction will only be employed adjacent to finds and where practical.

**D. Orientation
of Eradica-
tion/Control
Personnel**

Only trained and experienced personnel will be utilized initially. Replacement personnel will be trained by the individual being replaced. A period of 3 working days is necessary for the orderly transfer of these functions.

**E. Eradication/
Control
Records**

Records noting the location of detections, dates, number and type of treatments, and materials and formulations used will be maintained for all areas treated (see Addendum G).

F. Monitoring

An effective monitoring program will be implemented to aid in the evaluation of program efforts and environmental impact. The application and use of insecticides and other controlled substances will be assessed through the use of appropriate monitoring program criteria. The evaluation must effectively address Agency, cooperator, and public concerns.

The monitoring program will include at least the following elements:

1. Determine the efficacy of pesticide against the target pest.
2. Evaluation of dye cards to monitor aerial application.
 - a. Droplet size information.
 - b. Droplet distribution information.
 - c. Identification of wind drift components.
 - d. Verification of spray block boundaries.
 - e. Identification of skips.

3. Sampling to evaluate effect on environmental components.

- a. Water sampling to detect insecticide levels through direct application, leaching, and runoff.
- b. Soil sampling to determine insecticide levels and residues.
- c. Foliage sampling to identify residues.
- d. Biological organism sampling during applications and posttreatments to determine impact of insecticides.
- e. Air sampling to determine presence of pesticides in respirable air.

The monitoring program is to be a combined effort between the State in which the emergency program is being conducted and PPQ. If specific plans need to be developed for monitoring activities, Survey and Emergency Response Staff will request assistance and guidelines from other NPPS staffs.

V. CONTACTS

When an eggplant fruit borer eradication program has been implemented, its success will depend upon the voluntary cooperation, assistance, and understanding from other involved groups. The following is a list of groups which either are involved in or must be kept informed of all operational phases of an emergency program.

- A. Other Federal, State, county, and municipal agricultural officials
- B. Grower groups
- C. Commercial interests
- D. Universities
- E. State and local law enforcement officials
- F. Public health agencies
- G. Foreign agricultural interests
- H. National, State, and local news media
- I. General public

VI. ADDENDA

Addendum A--Definitions

Aerial Treatment:	Applying an insecticide by aircraft over a treatment area.
Buffer Area:	The area extending beyond the boundary of the core-- 1-, 2-, 3-km (0.6-, 1.24-, and 1.86-mi) buffer.
Cold Treatment:	The use of cold temperatures as a treatment on selected products alone or in conjunction with fumigation procedures.
Commercial Production Area:	An area where host material is grown for distribution.
Confirmed Detection:	A positive identification by a recognized expert of a submitted life form (specimen) as eggplant fruit borer.
Core Area:	A minimum distance of 1 km (0.6 mi) beyond any confirmed eggplant fruit borer detection.
Day Degrees:	The accumulation of heat units above a specified developmental temperature threshold during a life stage.
Delimiting Survey:	Determining the extent of the infestation in an area where eggplant fruit borer has been detected.
Detection:	The collection of any life stage of eggplant fruit borer.
Detection Survey:	An activity conducted in a susceptible area not known to be infested with eggplant fruit borer.
Epicenter/Focal Point:	The initial site of an infestation.
Fumigation:	The application of an approved fumigant as a treatment (methyl bromide) alone or in conjunction with cold treatment procedures.
Generation: (Life Cycle)	The period of time for the pest to complete all stages of development predicted by day degrees or on the basis of other biological information.
Ground Spray:	Using ground spray equipment to apply an insecticide to host vegetation in a eggplant fruit borer infested area.

Host: A plant species that provides for the potential reproduction of the eggplant fruit borer.

Host Collection/ The collection and holding of host material. To determine the extent and nature of an infestation.

Infestation: The collection of two or more eggplant fruit borer moths, a pupa, a larva, or mated female from an area or the detection of a single adult determined to be associated with a current infestation.

Infested Area: Three kilometers distance from all detection sites unless biological factors indicate the need for more or less area.

Leucinoides orbonalis
Guenee: The scientific name of the eggplant fruit borer.

Monitoring/Evaluation Survey: Using interdependent visual and trapping surveys conducted in an area where an insecticide treatment has been applied to evaluate the effectiveness of the application.

PPQ-APHIS-USDA: Plant Protection and Quarantine, Animal and Plant Health Inspection Service, United States Department of Agriculture.

Regulated Area: An area that extends at least 3 linear km (1.86 linear mi) in any direction from an infested property.

Regulatory Inspection: Visual examination of host material and containers plus discretionary trapping conducted around establishments where regulated articles are grown, handled, processed, or moved.

Steam Sterilization: The use of live steam as a treatment on selected products.

Trap Survey: Determining the presence or absence of a pest by the use of traps and an attractant placed in a predetermined pattern and serviced on a given schedule.

Urban/Residential Area: Noncommercial crop production area generally containing multiple or single family dwellings.

Visual Survey:

Examining hosts for eggs, larvae, and cocoons, either in the field or in regulated establishments, or in monitoring the movement of regulated articles.

Wilted Shoot:

A shoot that has been bored internally by the eggplant fruit borer and which as a consequence exhibits wilted leaves, stems, and growing parts, generally discolored and hanging, or in the last stages, the entire end toppled over. In severe cases, the whole plant is affected and falls over.

Addendum B--Safety

Personnel and public safety must be prime considerations at all times. Safety practices should be stressed in preprogram planning and through the duration of actual program operations. Supervisors must enforce on-the-job safety procedures. For complete instructions, see V, D, in the Emergency Programs Manual.

Addendum C--Hosts

The eggplant fruit borer host list is separated into preferred hosts and other recorded hosts. The hosts are listed by common and scientific names. The common names are arranged in a manner that is indicative of their usage. In all instances, an attempt has been made to use the most widely recognized common name. Those species without an accepted or approved common name are given at the end of the appropriate list.

PREFERRED

<u>Common Name</u>	<u>Scientific Name</u>
Eggplant	<u>Solanum melongena</u>
Potato	<u>Solanum tuberosum</u>
Tomato	<u>Lycopersicon esculentum</u>

OTHER

The literature indicates that these hosts will permit eggplant fruit borer development, but does not disclose all the conditions under which the host/pest relationship occurs.

<u>Common Name</u>	<u>Scientific Name</u>
Black nightshade	<u>Solanum nigrum</u>
Cape gooseberry	<u>Physalis peruviana</u>
Ground cherry, A	<u>Physalis minima</u>
Mango	<u>Mangifera indica</u>
Okra	<u>Abelmoschus esculentus</u>
Peas	<u>Pisum sativum</u>
Pepper	<u>Capsicum spp.</u>
Scarlet eggplant	<u>Solanum integrifolium</u>
Squash	<u>Cucurbita maxima</u>
Tree tomato	<u>Cyphomandra betacea</u>
Turkeyberry	<u>Solanum torvum</u>

No Common Name Available

Solanum indicum
Solanum xanthocarpum

Addendum D--Life History

1. SYSTEMATIC POSITION

Eggplant fruit borer, Leucinodes orbonalis Guenee (Lepidoptera--Pyralidae,
Pyraustinae)

Class: Insecta
Order: Lepidoptera
Family: Pyralidae
Subfamily: Pyraustinae

The genus Leucinodes has not been reviewed for some years, but is currently considered to be confined to the Old World from Asia and Africa where there are about a dozen known species. The New World species previously in this genus are now in a number of related genera. There is only one other related species of economic importance--Neoleucinodes elegantalis (Guenee).

2. IDENTIFICATION CHARACTERS

- Eggs: About 0.74 to 0.9 millimeter (mm) (0.03 to 0.04 in) in length, average 0.76 (0.03 in); in width 0.5 to 0.6 mm (0.02 to 0.03 in) with the average 0.56 mm (0.02 in); dull, creamy white and oval to elongate in appearance.
- Larvae: First instar very small 1.7 mm (0.07 in) in length, 0.2 mm (0.01 in) in width, body cylindrical, dirty white with dark-brown to black prominent head with six ocelli on each side in a circular arrangement, light-brown legs, white prolegs with hooklets in complete circles. Body covered with violet tubercles.
- Second instar creamy white with distinctly brownish head, spiracles clearly visible, ocelli now arranged in a semicircle. Length 4.5 mm (0.18 in), width 0.8 mm (0.03 in).
- Third instar 6.5 mm (0.26 in) in length and 1.4 mm (0.06 in) in width with well developed prothoracic shield bearing distinct markings, i.e., tubercles, warts. The thoracic legs are dark brown and the mandibles and clypeus are nearly black. Small brown spots now appear on the body with a fine hair in the center of each spot. Temporary reddish color over dorsal side before next molt.
- Fourth instar 9.3 mm (0.37 in) in length and 1.8 mm (0.07 in) in width. Loss of reddish color in 24 hours. May prepare a cocoon at this stage if adverse conditions exist. Remaining instars and pupal stage will pass inside cocoon.

Fifth instar 15 mm (0.6 in) in length and 4 mm (0.16 in) in width.

Sixth instar 16 to 20 mm (0.63 to 0.79 in) in length and 3 to 4 mm (0.12 to 0.16 in) in width, body pinkish brown with dark dorsal line, head chestnut brown, prothorax with brown dorsal plate.

Cocoon: Spheroid or oval shaped with hole at anterior end for exit of adult, about 10 to 14 mm (0.4 to 0.55 in) in length, 4.3 mm (0.17 in) in width. Appearance milky white at first, changing to dark brown in a few hours.

Diapausing Larvae: If adverse conditions occur and the larvae enter diapause, their appearance changes from a pinkish color to a faintly yellow color inside the cocoon.

Pupae: About 8 to 12 mm (0.32 to 0.47 in) in length and 3.3 mm (0.13 in) in width, reddish brown with a short cremaster possessing eight very finely hooked spines, abdomen almost straight, wing covers extended up to posterior margin of seventh abdominal segment.

Adults: About 6.9 mm (0.27 in) in length, forewings with wing expanse of 23 mm (0.91 in). Overall, predominately greenish brown, whitish forewings speckled with pinkish markings with tenth vein arising from the discal cell. Hind wings are opalescent with a black speck on the upper angle of the discal cell and another at the lower end. Head with a conspicuous conical projection on the frons.

NOTE: The only closely related species which could be confused with this species is Neoleucinodes prophetica found only in south Florida, Puerto Rico, Central America, and South America. This species differs by lack of a conical projection on the frons, is smaller with more translucent wings, and with a large basal patch connected to a brownish patch by a brown stripe running two-thirds out along the hind margin of the forewing.

3. BIOLOGY

A mated female flies at night, lands and deposits eggs singly, or sometimes in batches of two to four on the underside of leaves near the growing points of the host. The female may lay 48 to 53 eggs per night and total about 192 to 267 eggs over a period of about 4 days, at optimum temperatures of 30° C. (86° F.) and 70 to 90 percent relative humidity. Overlapping of generations occur since there can be

more than 10 generations in warm areas and two to three in cooler areas. The incubation period is normally 3 days under optimum conditions and 9 days at minimum developmental conditions of 15° C. (59° F.) with high mortality.

When the larvae hatch, they wander about for an hour or so, looking for a suitable entry point inside developing shoots, fruit buds, or fruit (if present). When shoots are bored, the upper part (including stem, leaves, fruit buds, and any fruit) wilts, dies, and falls over. This is a characteristic sign of injury. Main stems may also be bored and thick stems may be completely riddled by the borer with as many as 10 to 15 larvae. In this case, the whole plant wilts. When fruits are attacked, newly hatched larvae may first hide below the calyx by webbing externally and then boring into the fruit. Older instars will just bore straight into the fruit. The larvae bore inside the fruit on a persistent basis thereafter. Frass is thrown out through the bore holes, which may also be plugged or partly plugged by excreta.

EXCEPTION: If the host is a small berry fruit such as black nightshade, which is too small for the larvae, it will web three to four such fruits together and feed on them from the inside. Fruits are preferred for attack over other parts of the host and when present are the only part attacked. Infested fruit have been found to contain up to nine caterpillars of different age groups per fruit.

There are six instars. The first lasts for 2 to 3 days, the second for 3 to 4 days, and the third for only 1 to 2 days. The fourth instar may take 4 to 5 days. It is at this point that the larva will come out if disturbed, if the fruit begins to rot, or if conditions become unfavorable and prepare a cocoon within which it passes the fifth and sixth instars and the pupal stage. The fifth instar lasts 5 to 6 days and is marked by a slowdown in feeding activity and cocooning behavior is more pronounced. The sixth and final instar lasts for about 3 days, after which the larvae leave the fruit (or shoot) through a hole which is quite conspicuous. On emergence, they generally seek a dark place on the lower branches of the plant, in the fold of a leaf, on the stem of the host, or on the ground. Rarely, pupation takes place inside the fruit. In cold climates, the larvae will descend to the base of the host stem and cluster around the roots, spinning cocoons of silk and soil. The cocoons may be found at the stem base or just above, in the ground litter about the stem base, or up to 7.6 cm (3 in) under the soil surface. The winter is passed by the larvae, which remain in diapause for up to 8 months. In this manner, harsh winters with a temperature of -6.5° C. and spring temperature of 30° C. (20.3° to 86° F.) and snow covers of 1 to 2 m (3 1/4 to 6 1/2 feet) can be successfully weathered. The exact temperatures which break diapause is not known, but when this happens, the life cycle is completed with pupation and emergence. If conditions are suitable, there is no diapause and the larvae construct cocoons inside which they pass an inactive prepupal stage lasting 46 to 48 hours (2 days), during which the body contracts to about 11.3 mm (0.45 in) with many folds and wrinkles.

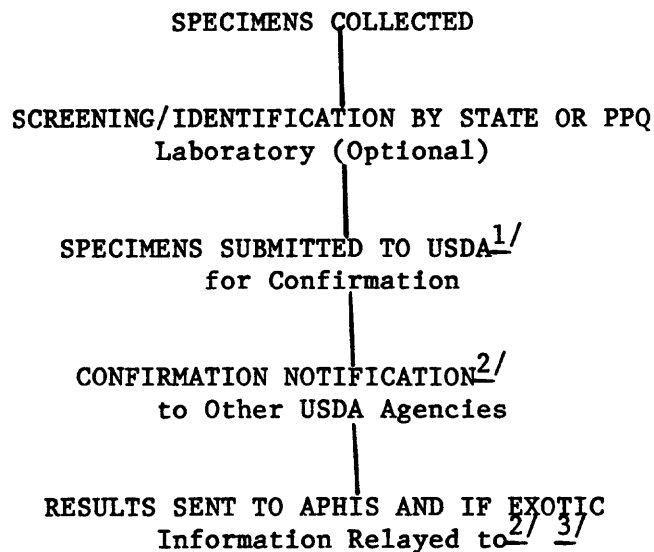
The pupal stage itself lasts for 8 to 9 days. The adults, when they emerge, rest upon the cocoons for about 15 minutes and then fly away. They fly only at night and generally does not fly far. The males have a short life of 4 to 5 days and die shortly after mating. The females have a preoviposition period of 4 days, dying after egg laying is finished.

The complete life cycle of the eggplant fruit borer ranges from 25 days under optimum conditions to 58 days under minimal conditions when diapause is not triggered. Average conditions result in a life cycle of 34 to 46 days as given above.

Addendum E--Identification of Specimens

As many specimens as possible of the pest are to be collected for identification by the local designated identifier. Suspect adult specimens should be forwarded dry in a small cardboard box and other stages in vials of alcohol for confirmation to 1/ below. These specimens must be accompanied by PPQ Form 391 marked "Urgent" (see PPQ Manual M390.500).

INFORMATION FLOW FOR THE IDENTIFICATION OF SPECIMENS



1/ APHIS/ARS^{1/}

1/ ARS

All States^{2/}

Insect Identification
and Beneficial Insect
Introduction Institute
Agricultural Research Service
U.S. Department of Agriculture
Building 476, BARC-EAST
Beltsville, Maryland 20705

NAPPO^{3/}

APHIS

Plant Protection and Quarantine

2/ All States

State and Territory Agricultural Regulatory Officials

3/ NAPPO

North American Plant Protection Organization

Addendum F--Technical Application Data

1. BLACKLIGHT TRAP

Blacklight traps commercially available from entomological supply companies may be used. NOTE: If a shortage of traps and/or resources develops as a consequence of a large, expensive operation, mercury vapor lamps may also be used. Alternatively, the number of traps outside the core areas may be reduced to one per square km. All traps should be properly set and timed for night operation only.

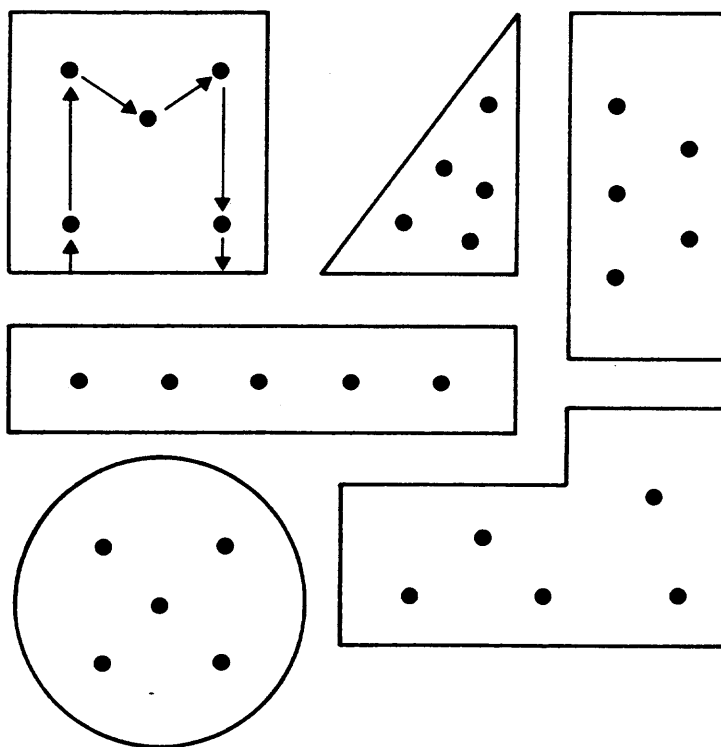
2. VISUAL SURVEY

Host fields with withered, toppled shoots, fallen stalks, fallen, rotting or webbed fruit, berries or vegetables, severe stunting, or poor growth receive the first priority in the surveys. Otherwise, they should be equally spaced, with the exception of a bias towards the center of each find.

Sampling should follow a similar pattern for each field being surveyed. Do not sample field borders, fence rows or ditchbacks unless other hosts grow there. In this case, a separate sample may be taken, particularly if in a core area. Very large fields may need to be divided into smaller units, with each unit counted as a separate field of a maximum of 4 hectares (10 acres). Not all such units should be sampled at the same time, in order to keep spacing of sample fields roughly equal (except as given above).

Before sampling, enter the field at least 23 meters (75 feet) and take samples at not less than five different locations in the field. Move from site to site, following a predetermined pattern such as given below.

Field Survey Pattern



At each location, 50 plants from three adjoining rows should be inspected at random, with a bias towards those showing signs of poor growth, stunting, rotting, webbed or fallen fruit, berries or vegetables, withered or toppled shoots, fallen stalks or stem breakage. The following should be investigated:

- Eggs: Look for clusters of two to four dull whitish eggs on the underside of leaves near growing points of the host.
- Larvae: Check shoots or fruit buds first. Then look at fruit under the calayx for holes, signs of decay, or webbing. Stems and stalks with any obvious damage should be split.
- Cocoons: Look on the stem, the fold of a leaf or on the ground for whitish to dark brown cocoons, expecially on the lower branches of the host. In fall or winter, the stem just above the ground and roots to 3 centimeters under the soil should be carefully examined. Sometimes cocoons may be found in the (berries or vegetables) particularly if the weather turns cold.
- Adults: Sometimes adults will be found on the leaves. These should be caught and destroyed or otherwise saved for identification.

If the infestation is heavy enough to warrant it, an estimate of the amount of infestation can be made. Another sample of 50 plants in the field can be taken, this time without bias towards unhealthy plants, so long as a given pattern is maintained, such as every fifth plant, up to three in a row in the first two rows, and four in the last row.

3. SANITATION

Sanitation will consist of the following measures to be applied depending on the circumstances and equipment available.

a. Plowing of Fields: If the infested area is relatively small or a given field is heavily infested, this measure will be highly effective for annual hosts. The host material must be dug up and collected for disposal (3.c, d, and e).

b. Cleaning: Hosts must be effectively cleaned of all fallen, rotting, webbed, punctured, or otherwise unhealthy fruit, berries or vegetables, wilted shoots, and bored stems cut off and any visible cocoons or adults destroyed. Host material will then be disposed (3.c, d, and e).

c. Burning of Debris: When host material is collected, it may be piled into heaps, and burned. The residue can then be buried in an approved landfill.

d. Animal Food: Host material may be used as animal food. Any residue will be disposed by burning and burial or burial at an approved landfill.

e. Bagged and Buried: Host material may be collected in suitable containers and transported to an approved landfill.

f. Vehicle Inspection/Cleaning: Vehicles, trucks, tractors, wagons, etc., used in host fields or to transport host material must be inspected to ensure that accidental movement of leaves, stalks, stems, stubble, etc., containing eggplant fruit borer larvae, eggs or cocoons does not occur. Cleaning consists of the removal and destruction of any host material found.

4. GROUND APPLICATION

The following pesticides may not be registered for this use on a given crop. Any application inconsistent with product labeling must have prior approval.

Fenvalerate (Pydrin® 2.4 EC)—158 to 315 milliliter (ml) (5 1/3 to 10 2/3 ounces (oz)) 45.36 to 90.7 g (1.6 to 3.2 avoirdupois (av) oz) active ingredient (a.i.) of 30 percent fenvalerate in 15 to 379 liter (L) (4 to 100 gallons (gal)) of water per acre, depending on type of equipment and crop/host being sprayed or 0.384 to 0.781 L (0.81 to 1.65 pints (pt)) 1/2 to 2.24 g (3.95 to 7.9 av oz) a.i. in 38 to 950 L (10 to 250 gal) of water per hectare. Apply as a full coverage spray and repeat at 5- to 10-day intervals.

Carbaryl (Sevin® XLR)—0.946 to 1.89 (L) (32 to 64 oz) 28.3 to 56.7 g (1 to 2 av oz) a.i. of 44 percent carbaryl in 0-378.5 L (100 gal) of water per acre depending on type of equipment and crop/host being sprayed or 2.34 to 4.67 L (79 to 158 oz) 70 to 140 g (2.47 to 4.94 av oz) a.i. in 375 to 935 L (99 to 247 gal) of water per hectare. Apply as a spray when detections are made and, thereafter, approximately 5 to 10 days apart.

5. AERIAL APPLICATION

The following pesticides may not be registered for this use on a given crop. Any application inconsistent with product labeling must have prior approval.

Carbaryl (Sevin® XLR)—0.96 to 1.89 L (32 to 64 oz) 2.83 to 56.7 g (1 to 2 av oz) a.i. of 44 percent carbaryl in 0 to 11.3 L (0 to 3 gal of water per acre depending on type of equipment and crop/host being sprayed or 2.34 to 4.67 L (79 to 158 oz) 70 to 140 g (2.47 to 4.94 av oz) a.i. in up to 28 L (0 to 7.4 gal) of water per hectare. Apply as a spray when detections are made and, thereafter, approximately 5 to 10 days apart.

Fenvalerate (Pydrin® 2.4 EC)—158 to 315 ml (5 1/3 to 10 2/3 oz) 45.36 to 90.7 g (1.6 to 3.2 av oz) a.i. of 30 percent fenvalerate in 3.8 to 18.9 L (1 to 5 gal) of water per acre, depending on type of equipment and crop/host being sprayed or 0.384 to 0.781 L (0.81 to 1.65 pt) 112 to 224 g (3.95 to 7.9 av oz) a.i. in 9.5 to 47 L (2.5 to 12.4 gal) of water per hectare. Apply as a spray when detections are made and, thereafter, approximately 5 to 10 days apart.

Addendum G--Forms

Addendum H--Contributors

Industry

D. Stapell, Manager, Information Services, United Fresh Fruit and Vegetable Association, Alexandria, Virginia

State Regulatory Officials

J. Dreves, Director, Plant Industry Division, Michigan Department of Agriculture, Lansing, Michigan

G. Karr, Plant Pathologist, Plant Industry, Alabama Department of Agriculture and Industries, Montgomery, Alabama

K. Roach, Specialist in Charge, Division of Plant Industry, Ohio Department of Agriculture, Reynoldsburg, Ohio

University

R. B. Chalfant, Professor, Department of Entomology, Georgia Coastal Plain Experimental Station, University of Georgia, Tifton, Georgia

S. R. Race, Professor, Department of Entomology, Cook College, New Brunswick, New Jersey

Governmental Agencies

R. L. Cowden, Senior Staff Officer, Survey and Emergency Response Staff, National Program Planning Staff, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Hyattsville, Maryland

C. S. Creighton, Research Entomologist, Vegetable Insect Research, Agricultural Research Service, U.S. Department of Agriculture, Charleston, South Carolina.

B. G. Lee, Assistant Director, Survey and Emergency Response Staff, National Program Planning Staff, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Hyattsville, Maryland

J. N. L. Stibick, Staff Entomologist, Survey and Emergency Response Staff, National Program Planning Staff, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Hyattsville, Maryland

Saxena, P. N., 1965. The life history and biology of Leucinodes orbonalis.
J. Zoo. Soc. India 17(1/2):64-70.

Shah, A. H., 1979. Field evaluation of some new insecticides against the brinjal fruit and shoot borer, Leucinodes orbonalis Guen. Indian J. of Ent. 41(2):195-196.

Subbaratnam, G. V. and Butani, D. K., 1982. Chemical control of insect pest complex of brinjal. Entomon 7(1):97-100.

Uthamasamy, S.; Gopalan, M.; and Venkatanarayanan, D., 1975. Insecticidal control of fruit-borer, Leucinodes orbonalis G. on Brinjal, Solanum melongena. Madras Agric. J. 62(3):169-170.